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L4   ANSWER 9 OF 22  CAPLUS  COPYRIGHT 2006 ACS on STN
AN   2001:840583  CAPLUS
DN   135:365366
ED   Entered STN:  19 Nov 2001
TI   Electrolytic plating method for forming copper layers with uniform
     thickness on semiconductor wafers
IN   Yagi, Yasushi
PA   Tokyo Electron, Ltd., Japan
SO   Jpn. Kokai Tokkyo Koho, 9 pp.
     CODEN: JKXXAF
DT   Patent
LA   Japanese
IC   ICM  C25D007-12
     ICS  H01L021-288; H05K003-18
CC   76-3 (Electric Phenomena)
     Section cross-reference(s): 72
FAN.CNT 1
     PATENT NO.          KIND   DATE       APPLICATION NO.        DATE
     ---------------     ----   --------   --------------------   --------
PI   JP 2001316869        A2    20011116   JP 2000-135243         20000508
PRAI JP 2000-135243             20000508
CLASS
 PATENT NO.       CLASS  PATENT FAMILY CLASSIFICATION CODES
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 JP 2001316869    ICM    C25D007-12
                  ICS    H01L021-288; H05K003-18
                  IPCI   C25D0007-12 [ICM,7]; H01L0021-288 [ICS,7]; H05K0003-18
                         [ICS,7]
                  IPCR   C25D0007-12 [I,A]; C25D0007-12 [I,C]; H01L0021-02
                         [I,C]; H01L0021-288 [I,A]; H05K0003-18 [N,A];
                         H05K0003-18 [N,C]
AB   The method is characterized in that (A) air bubbles are ejected
     from the interface of an object to be plated and a plating solution by
     circulating the overflowed solution and/or rotating the object and
     (B) plating the object while changing flow rate of the solution and/or
     rotation speed of the object.  Air bubble ejection may be confirmed by
     detecting the change of elec. current between a cathode and an anode.
ST   electrolytic plating copper layer uniform thickness; plating soln
     circulation air bubble ejection; semiconductor wafer rotation
     speed electrolytic plating
IT   Electrodeposition
       Semiconductor materials
         (electrolytic plating method including air bubble ejection process for
         forming uniform Cu layers on semiconductor wafers)
IT   7440-50-8, Copper, processes
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
         (electrolytic plating method including air bubble ejection process for
         forming uniform Cu layers on semiconductor wafers)
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L1: Entry 2 of 2 File: DWPI Nov 16, 2001

DERWENT-ACC-NO: 2002-182239
DERWENT-WEEK: 200224

TITLE: Electrolytic plating method for semiconductor manufacture, involves removing air bubbles from plating liquid circulated towards wafer, and accordingly flow rate of plating liquid is controlled

PATENT-ASSIGNEE:

ASSIGNEE	CODE
TOKYO ELECTRON LTD	TKEL

PRIORITY-DATA: 2000JP-0135243 (May 8, 2000)

Search Selected Search ALL Clear

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 2001316869 A	November 16, 2001		009	C25D007/12

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
JP2001316869A	May 8, 2000	2000JP-0135243	

INT-CL (IPC): C25 D 7/12; H01 L 21/288; H05 K 3/18

ABSTRACTED-PUB-NO: JP2001316869A
BASIC-ABSTRACT:

NOVELTY - The air bubbles generated during circulation of the plating liquid (11) towards the semiconductor wafer (W) in a plating bath, are removed by a pump. The flow rate of plating liquid is controlled, based on the air bubble control, during plating.

USE - For plating aluminum/copper wirings in semiconductor manufacture.

ADVANTAGE - Plate film of uniform thickness is obtained reliably due to effective air bubble control.

DESCRIPTION OF DRAWING(S) - The figure shows the wafer in immersed state of plating bath under air bubble removal process.

Plating liquid 11

(19)

(11) Publication number: **2001316869 A**

Generated Document.

PATENT ABSTRACTS OF JAPAN

(21) Application number: 2000135243

(51) Intl. Cl.: C25D 7/12 H01L 21/288

(22) Application date: 08.05.00

(30) Priority:

(43) Date of application publication: 16.11.01

(84) Designated contracting states:

(71) Applicant: TOKYO ELECTRON LTD

(72) Inventor: YAGI YASUSHI

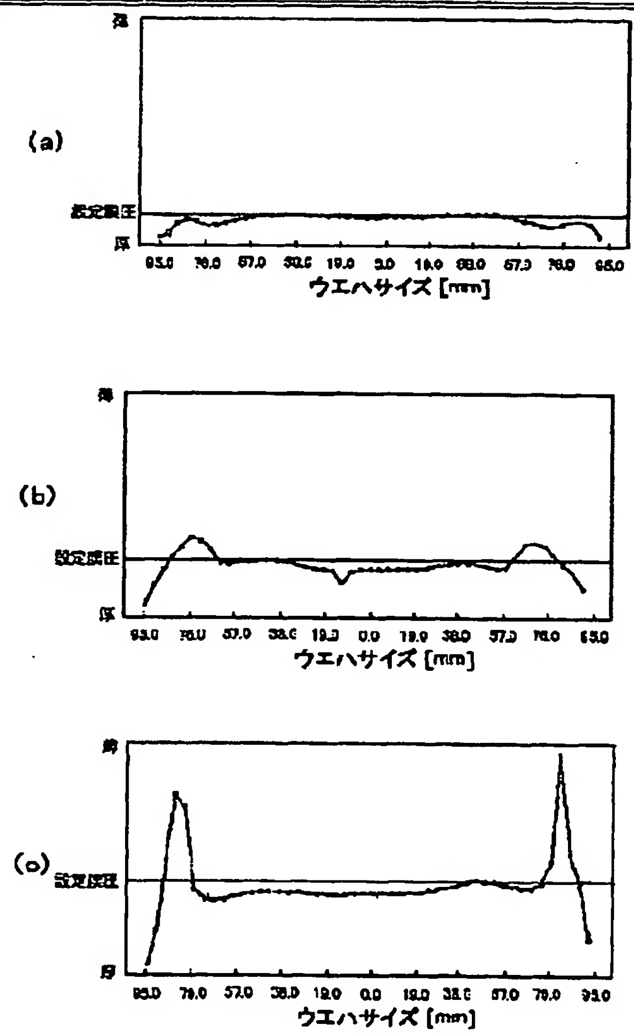
(74) Representative:

(54) ELECTROLYTIC PLATING METHOD

(57) Abstract:

PROBLEM TO BE SOLVED: To obtain a plated layer with a uniform film thickness, by improving a setting of a rotation speed of a semiconductor wafer W and a circulation flow rate of a plating solution 3 for driving out bubbles A without fail, in a plating process in which bubbles A are driven out from a treated surface of the semiconductor wafer W not to influence on the surface.

SOLUTION: This electrolytic plating method comprises a process of driving out the bubbles A dwelling on a liquid contacting surface of the semiconductor wafer W by rotating the semiconductor wafer W on a holding body 18 at a rotating speed of 30 rpm along while circulating a plating solution 11 at a flow rate of 5 L/minute through a pump 20 B when the semiconductor wafer W was immersed in the plating solution 11, and a process of subjecting the semiconductor wafer W to plating treatment after converting the flow rate of a plating solution 141 to 10 L/minute through the pump 20 B.



(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号
特開2001−316869
（P2001−316869A）
(43)公開日 平成13年11月16日(2001.11.16)

(51)Int.Cl.⁷	識別記号	F I	テーマコード゛(参考)
C２５Ｄ　7/12		C２５Ｄ　7/12	４Ｋ０２４
Ｈ０１Ｌ　21/288		Ｈ０１Ｌ　21/288	Ｅ　４Ｍ１０４
//Ｈ０５Ｋ　3/18		Ｈ０５Ｋ　3/18	Ｎ　５Ｅ３４３

審査請求 未請求 請求項の数４ ＯＬ （全 ９ 頁）

(21)出願番号 特願2000−135243(P2000−135243)

(22)出願日 平成12年５月８日(2000.5.8)

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東京エレクトロン株式会社
東京都港区赤坂５丁目３番６号

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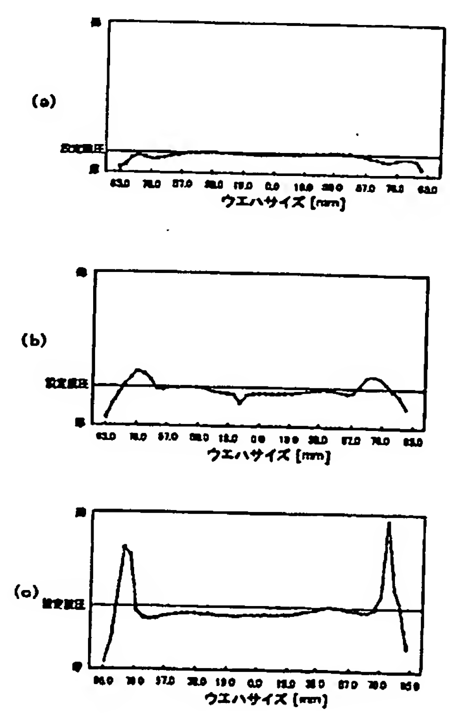
最終頁に続く

(54)【発明の名称】 電解メッキ方法

(57)【要約】

【課題】 半導体ウエハWの被処理面から気泡Ａを確実に追い出し気泡Ａの影響を排除して銅メッキを施すようにしているが、気泡Ａを確実に追い出す際の半導体ウエハWの回転速度やメッキ液３の循環流量の設定が難しく、均一な膜厚のメッキ層を得ることが極めて難しい。

【解決手段】 本発明の電解メッキ方法は、メッキ液１１内に浸漬した時にポンプ２０Ｂを介してメッキ液１１を５Ｌ／分の流量で循環させると共に保持体１８を介して半導体ウエハWを３０ｒｐｍの回転速度で回転させて半導体ウエハWの接液面に滞留する気泡Ａを追い出す工程と、ポンプ２０Ｂを介してメッキ液１４１の流量を１０Ｌ／分に変更して半導体ウエハWにメッキ処理を施す工程とを有する。



【特許請求の範囲】

【請求項１】　被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記メッキ液内に浸漬した時に上記循環駆動機構を介して上記メッキ液を循環させて上記被処理体の接液面に滞留する気泡を追い出す工程と、上記循環駆動機構を介して上記メッキ液の流量を変更して上記被処理体にメッキ処理を施す工程とを有することを特徴とする電解メッキ方法。

【請求項２】　被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記メッキ液内に浸漬した時に上記保持体を介して上記被処理体を回転させて上記被処理体の接液面に滞留する気泡を追い出す工程と、上記保持体を介して上記被処理体の回転速度を変更して上記被処理体にメッキ処理を施す工程とを有することを特徴とする電解メッキ方法。

【請求項３】　被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記メッキ液内に浸漬した時に上記循環駆動機構を介して上記メッキ液を循環させると共に上記保持体を介して上記被処理体を回転させて上記被処理体の接液面に滞留する気泡を追い出す工程と、上記メッキ液の流量及び上記被処理体の回転速度の少なくともいずれか一方を変更して上記被処理体にメッキ処理を施す工程とを有することを特徴とする電解メッキ方法。

【請求項４】　被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記被処理体に電流を印加する工程と、上記被処理体に電流を印加した状態で上記保持体を介して上記被処理体を上記メッキ液に浸漬する工程と、上記カソードと上記アノード間の電流変化を検出する工程とを有することを特徴とする電解メッキ方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電解メッキ方法に関する。

【０００２】

【従来の技術】半導体製造工程ではスパッタリング法、ＣＶＤ法等の種々の成膜方法が用いられている。そして、従来から配線材料としてアルミニウム等が広く用いられているが、半導体装置の微細化、薄膜化に伴ってより抵抗率の低い材料が求められている。最近ではアルミニウムに替わる配線材料として更に抵抗率の低い銅が注目されている。ところが、スパッタリング法による銅の成膜には溝や孔に対する埋め込み性に問題があり、また、ＣＶＤ法による銅の成膜には成膜後のエッチングが難しいという問題がある。そこで、メッキ法による成膜技術がクローズアップされている。メッキ法は前二者の方法と比較して装置コストが安く、プロセスコストも安い。特に、電解メッキはメッキ液として硫酸銅と種々の添加剤を使用するため、プロセスが安定し、管理し安く、成膜速度も速いとう種々の利点がある。そのため、電解メッキ法が銅の成膜技術として種々研究されている。

【０００３】そこで、図５を参照しながら従来の電解メッキ装置について説明する。従来の電解メッキ装置は、例えば同図に示すように、電解メッキ浴槽１、被処理体（例えば半導体ウエハ）Ｗを保持する保持体２を備えている。電解メッキ浴槽１には硫酸銅や添加剤等を含むメッキ液３が収容され、メッキ浴槽１の下部にはリング状のアノード４が配置されている。アノード４は例えば銅を主成分とする含リン銅が用いられる。一方、保持体２の下端には載置部２Ａが形成され、この載置部２Ａで半導体ウエハＷを外周縁部で支持する。この載置部２Ａの上面には全周に渡ってカソード２Ｂ（図６の（ａ）参照）が装着され、このカソード２Ｂは載置部２Ａに載置された半導体ウエハＷのシード層（図示せず）と導通可能になっている。そして、カソード２Ｂとアノード４は配線５Ａを介して定電流電源５に接続され、メッキ処理時に電圧を印加すると、カソード２Ｂとアノード４間に電流が流れ、半導体ウエハＷの表面に銅メッキを施すことができる。尚、カソード２Ｂの内径側にはリング状の

シール部材２Ｄ（図６参照）が装着され、電解メッキ時にメッキ液３がカソード２Ｂ側へ入り込まないようになっている。

【０００４】また、電解メッキ浴槽１は、例えば内槽１Ａと外槽１Ｂとからなり、側壁が二重構造になっている。更に、内槽１Ａ内は隔膜６を介して下室（以下、「アノード室」と称す。）１Ｃと上室（以下、「カソード室」と称す。）１Ｄに区画され、アノード室１Ｃにアノード４が配置されている。隔膜６はアノード室１Ｃ内での生成物のカソード室１Ｄ内への透過を防止している。また、電解メッキ浴槽１の底面中央を供給管７が貫通し、この供給管７は循環配管８を介して内槽１Ａと外槽１Ｂで形成される環状室１Ｅに連結されている。この循環配管８にはタンク８Ａ及びポンプ８Ｂが配置され、ポンプ８Ｂを介してカソード室１Ｄとタンク８Ａ間でメッキ液３を一定の流量で循環させると共に半導体ウエハWに対してメッキ液３を上昇流で供給するようにしている。また、アノード室１Ｃにも循環配管９が連結され、この循環配管９に配置されたタンク９Ａ及びポンプ９Ｂを介してタンク９Ａとアノード室１Ｃ間でメッキ液３を一定の流量で循環させている。

【０００５】また、図６に示すように上記保持体２の周壁には半導体ウエハWを搬出入するための開口部２Ｃが形成され、図示しない搬送用基板を介して保持体２内へ搬入するようになっている。図示してないが搬送用基板は真空吸着部を有し、半導体ウエハWを搬送用基板Ｐ上で吸着保持した状態で半導体ウエハWを搬出入する。

【０００６】次に動作について説明する。まず、図示しない搬送用基板が開口部２Ｃから保持体２内へ半導体ウエハWを搬入し、保持体２の載置部２Ａに半導体ウエハWを載置すると共に図示しないクランプ機構が作動して載置部２Ａに半導体ウエハWを図６の（ａ）～（ｃ）に矢印で示すように押圧して固定する。また、電解メッキ浴槽１ではポンプ８Ｂ、９Ｂを駆動し、アノード室１Ｃ及びカソード室１Ｄ内のメッキ液３をそれぞれのタンク８Ａ、９Ａとの間で循環させる。この状態で保持体２を介して半導体ウエハWを図６の（ａ）に示すように電解メッキ浴槽１のカソード室１Ｄに浸漬すると、半導体ウエハWの被処理面に気泡Ａが滞留する。そこで、保持体２を介して半導体ウエハWを回転させ、メッキ液３の一定流量の上昇流と相俟って気泡Ａを追い出した後、所定の電圧を印加すると、メッキ液３を介してアノード４とカソード２Ｂ間に電流が流れ、半導体ウエハWに対して銅メッキが施される。この際、カソード室１Ｄ内では図５に矢印で示すようにメッキ液３の一定流量の上昇流が形成され、しかも半導体ウエハWが保持体２を介して回転しているため、半導体ウエハWに接触するメッキ液３を常に更新し、安定した銅メッキが行われる。

【０００７】ところで、半導体ウエハWに銅メッキを施す場合には、半導体ウエハWをメッキ液３に浸漬した後、半導体ウエハWを一定の回転速度で回転させると共にメッキ液３を一定の流量で循環させて被処理面内の気泡Ａを追い出した後、半導体ウエハWの被処理面に銅メッキ層を形成している。

【０００８】

【発明が解決しようとする課題】しかしながら、従来の電解メッキ方法に場合には、半導体ウエハWの被処理面から気泡Ａを確実に追い出し気泡Ａの影響を排除して銅メッキを施すようにしているが、気泡Ａを確実に追い出す際の半導体ウエハWの回転速度やメッキ液３の循環流量の設定が難しく、均一な膜厚のメッキ層を得ることが極めて難しいという課題があった。

【０００９】本発明は、上記課題を解決するためになされたもので、均一な膜厚のメッキ層を確実に得ることができる電解メッキ方法を提供することを目的としている。

【００１０】

【課題を解決するための手段】本発明者は、上記課題を解決するために均一な膜厚のメッキ層を得るためにメッキ処理の条件、特に気泡Ａを確実に追い出すための保持体２の回転速度やメッキ液３の循環流量について詳細に検討した結果、以下の知見を得た。例えば気泡Ａを迅速に追い出すにはある程度の回転速度が必要になるが、回転速度が速すぎると却って気泡Ａが被処理面の中央に集まって気泡Ａ抜けないことが判った。また、逆に保持体２の回転速度が遅すぎると半導体ウエハWのシード層がメッキ液３に溶け出してメッキ層が不均一になることも判った。更に、メッキ液３の循環流量に関してはメッキ層の均一性を確保するには気泡追い出し時とメッキ処理時には特定の条件を設定してメッキ液３を循環させなくてはならないことが判った。

【００１１】本発明は上記知見に基づいてなされたもので、請求項１に記載の電解メッキ方法は、被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記メッキ液内に浸漬した時に上記循環駆動機構を介して上記メッキ液を循環させて上記被処理体の接液面に滞留する気泡を追い出す工程と、上記循環駆動機構を介して上記メッキ液の流量を変更して上記被処理体にメッキ処理を施す工程とを有することを特徴とするものである。

【００１２】また、本発明の請求項２に記載の電解メッキ方法は、被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に

配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記メッキ液内に浸漬した時に上記保持体を介して上記被処理体を回転させて上記被処理体の接液面に滞留する気泡を追い出す工程と、上記保持体を介して上記被処理体の回転速度を変更して上記被処理体にメッキ処理を施す工程とを有することを特徴とするものである。

【００１３】また、本発明の請求項３に記載の電解メッキ方法は、被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記メッキ液内に浸漬した時に上記循環駆動機構を介して上記メッキ液を循環させると共に上記保持体を介して上記被処理体を回転させて上記被処理体の接液面に滞留する気泡を追い出す工程と、上記メッキ液の流量及び上記被処理体の回転速度の少なくともいずれか一方を変更して上記被処理体にメッキ処理を施す工程とを有することを特徴とするものである。

【００１４】また、本発明の請求項４に記載の電解メッキ方法は、被処理体にメッキ処理を施すためのメッキ液を収容する電解メッキ浴槽と、この電解メッキ浴槽内に配置されたアノードと、このアノードと対をなすカソードを有し且つ被処理体をカソードと導通可能に保持する移動及び回転可能な保持体と、上記メッキ液を上記メッキ浴槽からオーバーフローさせて循環させる循環駆動機構とを備え、上記保持体を介して上記電解メッキ浴槽内のメッキ液に上記被処理体を浸漬した状態で回転させながらメッキ処理を施す電解メッキ方法であって、上記被処理体に電流を印加する工程と、上記被処理体に電流を印加した状態で上記保持体を介して上記被処理体を上記メッキ液に浸漬する工程と、上記カソードと上記アノード間の電流変化を検出する工程とを有することを特徴とするものである。

【００１５】

【発明の実施の形態】以下、図１～図４に示す実施形態に基づいて本発明を説明する。まず、本発明の電解メッキ方法に用いられる電解メッキ装置について説明する。この電解メッキ装置１０は、例えば図１の（ａ）、（ｂ）に示すように、被処理体（例えば、半導体ウエハ）Ｗに銅メッキを施すためのメッキ液１１を収容する電解メッキ浴槽１２と、この電解メッキ浴槽１２内を下室１３と上室１４に区画する隔膜１５と、この隔膜１５を介して区画された下室１３内に配置されたアノード１６と、このアノード１６と対をなすカソード１７を有し且つ半導体ウエハＷをカソード１７（図１の（ｂ）参照）と導通可能に保持する保持体１８とを備え、電解メッキ浴槽１２内のメッキ液１１に半導体ウエハＷを浸漬して銅メッキを施すようにしてある。尚、以下では下室はアノード室、上室はカソード室として説明する。

【００１６】而して、上記電解メッキ浴槽１２は、例えば内槽１２Ａと外槽１２Ｂを備えた二重壁構造として構成されている。この電解メッキ浴槽１２の底面には供給管１９が貫通して設けられている。隔膜１５は中央に孔を有している。隔膜１５の孔は供給管１９の上端部に連結され、その外周端は内槽１２Ａの周壁に連結され、隔膜１５を介して上述のように電解メッキ浴槽１２が上下に区画されている。また、アノード１６は例えば銅を主成分とする含リン銅によって形成され、カソード１７は例えば白金メッキが施されたステンレスによって櫛歯状に形成されている。保持体１８は図示しない駆動機構を介して少なくとも適宜の設定速度で昇降及び回転するように構成されている。この隔膜１５は例えば酸化チタンが含有されたポリフッ化ビニリデンを延伸成形したメンブレンフィルタとして形成され、例えばアノード室１３内で生成した不純物が透過しないようにしてある。

【００１７】上記供給管１９の上端はカソード室１４内で開口し、その下端は循環配管２０の一端に接続されている。この循環配管２０にはタンク２０Ａ及びポンプ２０Ｂが配置され、循環配管２０の他端は内槽１２Ａと外槽１２Ｂ間の環状室２１の底面に接続されている。従って、ポンプ２０Ｂの駆動によりタンク２０Ａ内のメッキ液１１が供給管１９を経由してカソード室１４内へ供給され、その殆どがカソード室１４を上昇して半導体ウエハＷの被処理面に接触した後、カソード室１４から環状室２１へオーバーフローする。オーバーフローしたメッキ液１１は循環配管２０を経由してタンク２０Ａ内へ戻り、カソード室１４とタンク２０Ａ間で繰り返し循環する。また、アノード室１３の底面にも循環配管２２が接続され、この循環配管２２にはタンク２２Ａ及びポンプ２２Ｂが配置されている。従って、タンク２２Ａ内のメッキ液１１はカソード室１４の場合と同様にポンプ２２Ｂの駆動によりアノード室１３とタンク２１Ａとの間で繰り返し循環する。

【００１８】また、上記保持体１８は、例えば図１の（ａ）示すように、上端が閉じた筒状に形成され、その下端に内方へ水平に延びる半導体ウエハＷの載置部１８Ａがフランジ状に形成されている。そして、この保持体１８には例えばエアシリンダ２４Ａ及び２５Ａを介して昇降可能に構成された真空チャック２４及びクランプ機

構２５が取り付けられ、これらの機構２４、２５を介して図示しないウエハ搬送機構との間で半導体ウエハWの受け渡しを行うようになっている。真空チャック２４は半導体ウエハWの中央を真空吸着して保持する。クランプ機構２５はリング状に形成され、半導体ウエハWの外周縁部を押圧、固定する。クランプ機構２５は、必要に応じて陣笠状等適宜の形状を採用することができる。また、保持体Ａ１８の載置部１８Ａには同図の（ｂ）に示すようにカソード１７が装着され、カソード１７の内側には弾性のあるシール部材２３が装着されている。

【００１９】そして、保持体１８の周壁には半導体ウエハWを搬出入するための開口部１８Ｂが形成され、この開口部１８Ｂから保持体１８内に搬入された半導体ウエハWを真空チャック２４によって真空吸着した後、真空チャック２４が下降して半導体ウエハWを載置部１８Ａへ載置する。引き続き真空チャック２４が上昇する一方、クランプ機構２５が下降して半導体ウエハWの外周縁部を載置部１８Ａへ押圧する。これにより半導体ウエハWはシール部材２３で保持体１８内を外部から遮断すると共に、半導体ウエハWに形成されたシード層（図示せず）がカソード１７と電気的に導通自在になる。

【００２０】また、上記アノード１６とカソード１７は、図１の（ａ）に示すように、配線２６を介して定電流電源２７に接続されている。従って、保持体１８を介して半導体ウエハWを電解メッキ浴槽１２のカソード室１４内に浸漬し、定電流電源２７を印加するとメッキ液１１を介して電気的に導通自在になり、カソード室１４では半導体ウエハWの被処理面に銅メッキが施されてメッキ面が形成される。

【００２１】更に、上記電解メッキ装置１０は保持体１８及びポンプ２０Ｂ、２２Ｂを制御する制御装置（図示せず）を備え、メッキの処理条件によって少なくとも保持体１８の回転速度やポンプ２０Ｂ、２２Ｂによるメッキ液１１の循環速度（流量）を最適制御するようにしてある。そして、この制御装置の働きで保持体１８、換言すれば半導体ウエハWの回転速度やカソード室１４内のメッキ液１１の循環流量（上昇流量）を制御することで本発明の電解メッキ方法を実施することができる。従来の電解メッキ方法では気泡Ａを追い出す時とメッキ処理を行う時の半導体ウエハへの回転速度及びメッキ液の上昇流量を共に同一に設定していたため、気泡追い出し時の最適条件とメッキ時の最適条件が一致せず、均一な膜厚が得られなかったものと思われる。

【００２２】そこで、本発明では半導体ウエハWを浸漬した後被処理面内に滞留する気泡Ａを追い出す時とメッキを行う時の保持体１８の回転速度及び／またはメッキ液１１の上昇流量をそれぞれ制御装置を介して適宜変更することで均一な膜厚の銅メッキ層を得るようにしている。

【００２３】本発明では気泡Ａを追い出す時には、保持体１８の回転速度を２０～６０ｒｐｍに設定することが好ましい。この範囲の回転速度では気泡Ａを一秒以内という極めて短い時間で追い出すことができる。２０ｒｐｍ未満では気泡Ａの追い出しに長時間を要すると共に半導体ウエハWのシード層が溶け出す虞がある。８０ｒｐｍを超えると気泡Ａが被処理面の中央に集中して気泡Ａを追い出せない虞がある。また、メッキ液１１の上昇流に関して云えば、その上昇流量を０～８Ｌ／分に設定することが好ましい。この範囲の上昇流量では気泡Ａを１秒以内に追い出すことができる。１０Ｌ／分を超えるとメッキ液１１の液面が荒れ、気泡Ａを半導体ウエハWの被処理面と保持体１８の載置部１８Ａで形成する隅角部に気泡Ａを封じ込め、却って気泡Ａを追い出し難くなる虞がある。上昇流量が０Ｌ／分というのは保持体１８が上述の回転速度範囲で回転していることを前提にしてのことである。

【００２４】また、気泡Ａを追い出し後のメッキ時には半導体ウエハWの被処理面の接液面近傍の銅イオンを一定の濃度に安定化するために気泡追い出し時よりある程度大きな流量の上昇流でメッキ液１１を供給し、被処理面に接するメッキ液１１を迅速に更新するようにしている。更に、被処理面全面の銅イオン濃度を均一化するためにも気泡追い出し時よりある程度大きな回転速度で半導体ウエハWを回転させるようにしている。これにより被処理面での銅イオン濃度の均一化、ひいては銅イオン層の膜厚の均一化を達成することができる。

【００２５】更に、本発明では気泡Ａを確実に追い出したか否かは導通テストによって確認するようにしている。即ち、カソード室１４内のメッキ液１１を所定の上昇流量で循環させた状態で半導体ウエハWをカソード室１４内に浸漬した後、半導体ウエハWを所定の回転速度で回転させる。この直後にアノード１６とカソード１７間に微小電流を流し、この時の抵抗値または電流値を測定し、その急激な変化を観察することで、気泡Ａが滞留しているか否かを確認するようにしている。即ち、電流値が急激に大きくなるか、抵抗値が急激に小さくなるかで気泡Ａの追い出しを確認することができる。そして、それぞれの値が変化せず一定値に達した時点で気泡Ａが完全に追い出されたことが確認できる。

【００２６】次に、図１～図４を参照しながら本発明方法の一実施例及び比較例について説明する、尚、ここでは直径２００ｍｍの半導体ウエハを用いた。［実施例１］本実施例ではまず、図２の（ａ）、（ｂ）に示すように搬送用基板Ｐを介して半導体ウエハWが保持体１８の開口部１８Ｂから保持体１８内へ搬入すると、真空チャック２４が駆動し、図２の（ｃ）に示すように半導体ウエハWを真空吸着する。引き続き搬送用基板Ｐが半導体ウエハWの真空吸着を解除し保持体１８内から後退すると、図２の（ｄ）に示すように真空チャック２４がエアシリンダ２４Ａを介して載置部１８Ａまで下降して半

導体ウエハWを載置部１８Ａ上へ載置すると共にクランプ機構２５がエアシリンダ２５Ａを介して下降し、同図の矢印で示すように半導体ウエハWの外周縁部をシール部材２３の弾力に抗して載置部１８Ａ上に押圧、固定する。これによりシール部材２３が弾性変形し保持体１８内を外部から遮断すると共に半導体ウエハWのシード層とカソード１７が電気的に接触し、これら両者W、１７が導通可能な状態になる。この間に図２の（ｅ）に示すようにクランプ機構２５と入れ替わりに真空チャック２４が半導体ウエハWから上昇する。尚、以下の図ではクランプ機構２５の図示を省略し、その押圧方向のみを矢印で図示してある。

【００２７】また、電解メッキ浴槽１２ではポンプ２０Ｂ、２２Ｂが駆動し、タンク２０Ａ、２２Ａ内のメッキ液１１をカソード室１４及びアノード室１３内へ供給し、カソード室１４及びアノード室１３とそれぞれのタンク２０Ａ、２２Ａとの間でメッキ液１１が循環し、図３（ａ）～（ｃ）の矢印で示すようにカソード室１４内では常にメッキ液１１の上昇流が形成されている。この際、カソード室１４内のメッキ液１１の上昇流量を５Ｌ／分に設定した。

【００２８】メッキ液１１が循環している時、図３の（ａ）に示すように保持体１８を介して半導体ウエハWが水平状態で下降しメッキ液１１に浸漬した後、制御装置を介して保持体１８を３０ｒｐｍの回転速度で回転させた。浸漬の初期段階では半導体ウエハWの被処理面内に半導体ウエハWの下側に気泡Ａが滞留しているが、図３の（ｂ）に示すように半導体ウエハWの回転と相俟ってメッキ液１１の上昇流によって気泡Ａを半導体ウエハWの被処理面から保持体１８外へ追い出した（図３の（ｃ）参照）。気泡Ａの追い出しは一秒以内で終了する。気泡の追い出しの終了は半導体ウエハWを浸漬した時に印加した微小電流による抵抗値の変化で確認した。

【００２９】気泡Ａがなくなったことを確認した後、カソード室１４内のメッキ液１１の流量を５Ｌ／分から１０Ｌ／分に変更すると共に、定電流電源２７から所定の電圧を印加して銅メッキを開始し、４分３０秒間メッキ処理を行った。メッキ終了後、逆の順序で半導体ウエハWをメッキ液１１から引き上げて保持体１８内から搬出し半導体ウエハWのメッキ面の膜厚を測定した。尚、気泡の追い出しを含めたメッキ処理の時間は４分３０秒であった。この処理によって得られた半導体ウエハWの銅メッキ層の膜厚を測定した結果を図４の（ａ）に示した。この図に示すグラフは横軸が半導体ウエハWの寸法を示し、横軸の中央が半導体ウエハWの中心である。縦軸は銅メッキ層の膜厚の変化を示している。縦軸の上になるほど膜厚が薄い（成膜不良により抵抗値が高い）ことを示している。このグラフの示す結果によれば、半導体ウエハWの銅メッキ層が均一な膜厚であることが判った。

【００３０】［比較例１］本比較例では、メッキ処理時のメッキ液１１の上昇流量を気泡追い出し時の流量と同一に設定した以外は、実施例１と同様にメッキ処理を行った。このメッキ処理によって得られた半導体ウエハWの銅メッキ層の膜厚を測定し、その結果を図４の（ｂ）に示した。このグラフの示す結果によれば、半導体ウエハWの中心部の膜厚がやや厚く、外周端部の膜厚がやや薄く、実施例１と比較して均一性に劣ることが判った。

【００３１】［比較例２］本比較例では、終始メッキ液１１を循環させないで静止させた以外は実施例１と同一の条件で気泡の追い出し及びメッキ処理を行った。このメッキ処理によって得られた半導体ウエハWの銅メッキ層の膜厚を測定し、その結果を図４の（ｃ）に示した。このグラフの示す結果によれば、半導体ウエハWの外周端部の抵抗値が極端に高く、成膜不良になっていることが判った。従って、半導体ウエハWの被処理面と保持体１８の載置部１８Ａの隅角部の気泡Ａが抜けずに残っている証である。

【００３２】以上説明したように本実施形態によれば、メッキ液１１内への半導体ウエハ浸漬した後、半導体ウエハWを３０ｒｐｍの回転速度で回転させると共にメッキ液１１を５Ｌ／分の上昇流量で循環させて被処理面内の気泡Ａを追い出した後、メッキ液１１の上昇流量を１０Ｌ／分に変更して銅メッキを行ったため、半導体ウエハWの被処理面内から気泡Ａを短時間で確実に追い出すことができ、しかも被処理面全面の銅イオン濃度を均一化することができ、均一な膜厚の銅メッキ層を安定的に得ることができる。また、気泡Ａを追い出している間にアノード１６とカソード１７間に微小電流を印加し、抵抗値の変化を観ることによって気泡Ａが完全に抜けたか否かを確実に知ることができる。

【００３３】尚、上記実施形態では気泡を追い出す時のメッキ液の上昇流量よりもメッキ処理を行う時のメッキ液の上昇流量を大きく設定した場合について説明したが本発明者は、メッキ液の流量を変化させずにメッキ時の被処理体の回転速度を気泡を追い出す時よりも大きく設定しても同様の結果が得られることを確認している。また、両方の方法を組み合わせても同様の結果が得られることを確認している。また、上記実施形態では被処理体として半導体ウエハを例に挙げて説明したが、本発明はＬＣＤ用基板についても適用することができる。

【００３４】

【発明の効果】本発明の請求項１～請求項３に記載の発明によれば、均一な膜厚のメッキ層を確実に得ることができる電解メッキ方法を提供することができる。

【００３５】また、本発明の請求項４に記載の発明によれば、メッキ処理を行う際に被処理体の被処理面内の気泡が確実に抜けたか否かを確認することができる電解メッキ方法を併せて提供することができる。

【図面の簡単な説明】

【図１】本発明の電解メッキ装置の一実施形態を示す模式図である。

【図２】（ａ）～（ｅ）は図１に示す電解メッキ装置において半導体ウエハを電解メッキ浴槽内に浸漬するまでの動作を示す説明図である。

【図３】図１に示す電解メッキ装置において半導体ウエハを電解メッキ浴槽内に浸漬し気泡を追い出す状態を示す図で、（ａ）は保持体を介して半導体ウエハを電解メッキ浴槽内に浸漬した状態を示す断面図、（ｂ）、（ｃ）はそれぞれ半導体ウエハの被処理面に滞留する気泡を追い出す状態を示す断面図である。

【図４】図１に示す電解メッキ装置を用いて得られた半導体ウエハの膜厚を示す図で、（ａ）は本発明方法によって得られた膜厚を示すグラフ、（ｂ）、（ｃ）はその比較例を示すグラフである。

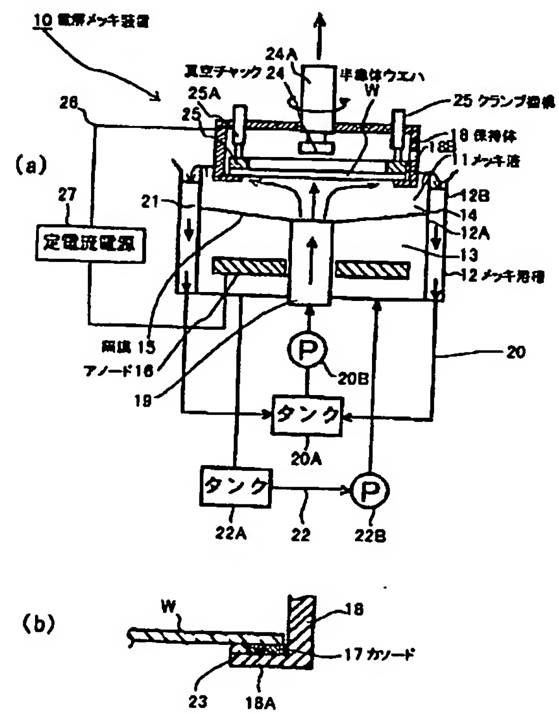
【図５】従来の電解メッキ装置を示す図１に相当する断面図である。

【図６】図６に示す電解メッキ装置において半導体ウエハを電解メッキ浴槽内に浸漬するまでの動作を示す説明図である。

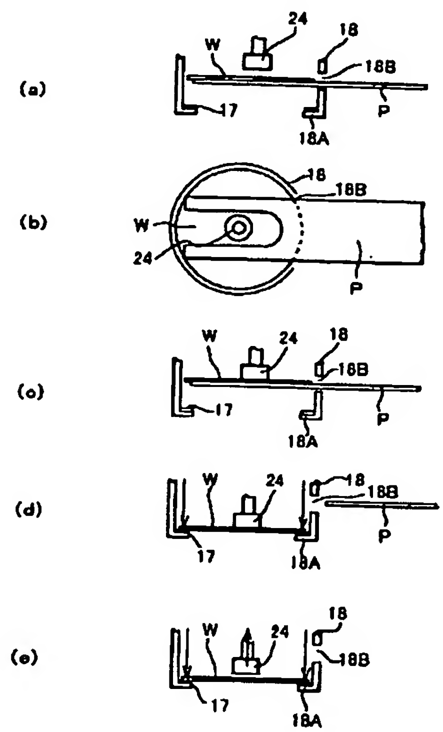
【符号の説明】

１０　電解メッキ装置
１１　メッキ液
１２　電解メッキ浴槽
１６　アノード
１７　カソード用シート
１８　保持体
２０Ｂ　ポンプ（循環駆動機構）
Ｗ　半導体ウエハ

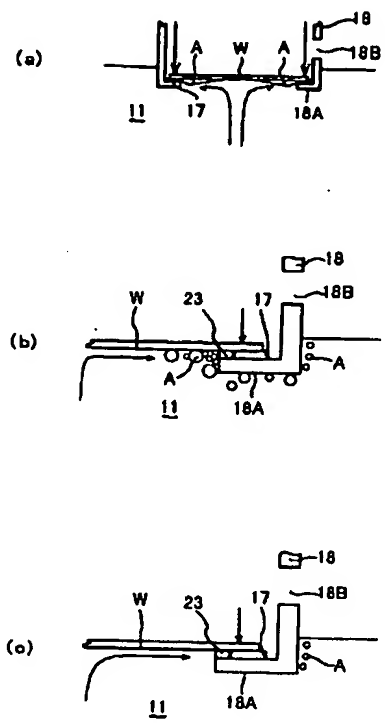
【図１】



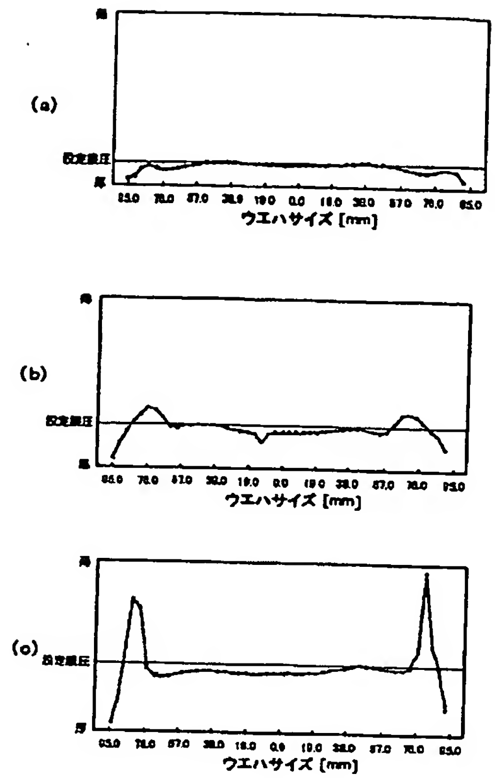
【図２】



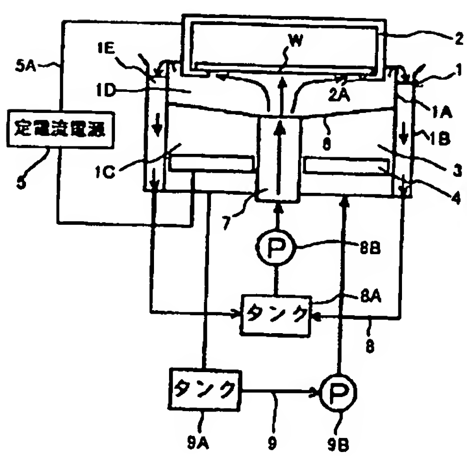
【図3】


(a)
18
18B
A
W
A
11
17
18A
(b)
W
23
17
18
18B
A
11
18A
(c)
W
23
17
18
18B
A
11
18A

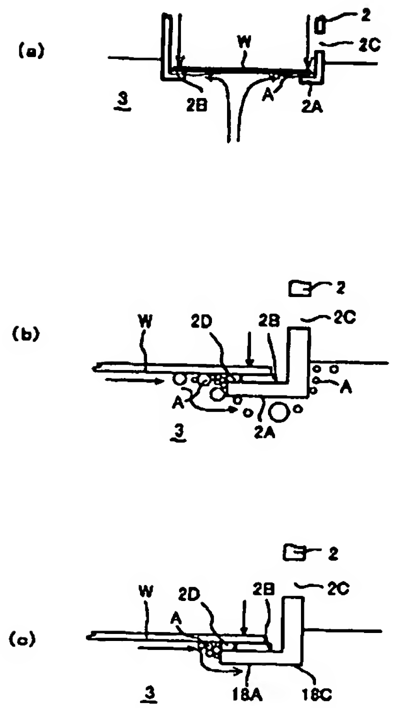
【図4】


(a)
(b)
(c)
薄
厚
設定膜厚
ウエハサイズ [mm]

【図5】


W
2
1
1E
1D
2A
1A
1B
5A
定電流電源
5
1C
6
3
4
7
P
8B
タンク
8A
8
タンク
P
9A
9
9B

【図6】



フロントページの続き

Fターム(参考)　4K024 AA09 AB01 AB08 BA11 BA15
BB09 BB12 BC10 CA10 CB16
FA05 GA02 GA16
4M104 BB04 DD52 HH20
5E343 AA03 AA22 BB24 BB71 DD44
DD45 FF16 GG06

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electrolytic plating approach.
[0002]
[Description of the Prior Art] In the semi-conductor production process, the various membrane formation approaches, such as the sputtering method and a CVD method, are used. And although aluminum etc. is widely used as a wiring material from the former, the ingredient with more low resistivity is called for with detailed-izing of a semiconductor device, and thin-film-izing. Recently, copper with still lower resistivity attracts attention as a wiring material replaced with aluminum. However, there is a problem in membrane formation of the copper by the sputtering method at the embedding nature to a slot or a hole, and there is a problem that etching after membrane formation is difficult in membrane formation of the copper by the CVD method. Then, a close-up of the membrane formation technique by plating is taken. As compared with front 2 persons' approach, equipment cost of plating is cheap and its process cost is also cheap. in order that it may use a copper sulfate and various additives as plating liquid, a process is stabilized, and especially electrolytic plating is managed, if it is cheap and its membrane formation rate is also quick, it will be obtained, and has various advantages. Therefore, electrolysis plating is variously studied as a copper membrane formation technique.
[0003] Then, the conventional electrolysis gilding machine is explained, referring to drawing 5 . The conventional electrolysis gilding machine is equipped with the supporter 2 holding the electrolytic plating organ bath 1 and the processed object (for example, semi-conductor wafer) W as shown in this drawing. The plating liquid 3 which contains a copper sulfate, an additive, etc. in the electrolytic plating organ bath 1 is held, and the ring-like anode 4 is arranged at the lower part of the plating organ bath 1. The phosphorus-containing copper with which an anode 4 uses copper as a principal component is used. On the other hand, installation section 2A is formed in the lower limit of a supporter 2, and the semi-conductor wafer W is supported by this installation section 2A at a periphery edge. The top face of this installation section 2A is equipped with cathode 2B (refer to (a) of drawing 6) over the perimeter, and the seed layer (not shown) of the semi-conductor wafer W laid in installation section 2A and the flow of this cathode 2B are attained. And a current can flow between cathode 2B and an anode 4, and cathode 2B and an anode 4 can perform coppering to the front face of the semi-conductor wafer W, if it connects with a constant current power supply 5 through wiring 5A and an electrical potential difference is impressed at the time of plating processing. In addition, the bore side of cathode 2B is equipped with ring-like seal member 2D (refer to drawing 6), and plating liquid 3 enters to a cathode 2B side at the time of electrolytic plating.
[0004] Moreover, the electrolytic plating organ bath 1 consists of inner lift 1A and outside tub 1B, and the side attachment wall has dual structure. Furthermore, in inner lift 1A, it is divided by bottom room ("anode room" is called hereafter.) 1C and top room ("cathode room" is called hereafter.) 1D through a diaphragm 6, and the anode 4 is arranged at anode room 1C. The diaphragm 6 has prevented transparency into cathode room 1D of the product within anode room 1C. Moreover, a supply pipe 7

penetrates the center of a base of the electrolytic plating organ bath 1, and this supply pipe 7 is connected with annular room 1E formed by inner lift 1A and outside tub 1B through the circulation piping 8. Tank 8A and pump 8B are arranged at this circulation piping 8, and while circulating plating liquid 3 by the fixed flow rate between cathode room 1D and tank 8A through pump 8B, he is trying to supply plating liquid 3 by upward flow to the semi-conductor wafer W. Moreover, the circulation piping 9 is connected also with anode room 1C, and plating liquid 3 is circulated by the fixed flow rate between tank 9A and anode room 1C through tank 9A and pump 9B which have been arranged at this circulation piping 9.
[0005] Moreover, as shown in drawing 6 , opening 2C for carrying out taking-out close [of the semi-conductor wafer W] is formed in the peripheral wall of the above-mentioned supporter 2, and it carries in into a supporter 2 through the substrate for conveyance which is not illustrated. Although not illustrated, the substrate for conveyance has the vacuum adsorption section, and where adsorption maintenance of the semi-conductor wafer W is carried out on the substrate P for conveyance, it carries out taking-out close [of the semi-conductor wafer W].
[0006] Next, actuation is explained. First, it presses and the semi-conductor wafer W is fixed to installation section 2A at (a) - (c) of drawing 6 , as the clamp device which is not illustrated while the substrate for conveyance which is not illustrated carries in the semi-conductor wafer W into a supporter 2 from opening 2C and lays the semi-conductor wafer W in installation section 2A of a supporter 2 operates and an arrow head shows. Moreover, in the electrolytic plating organ bath 1, Pumps 8B and 9B are driven and the plating liquid 3 in anode room 1C and cathode room 1D is circulated between each tank 8A and 9A. If the semi-conductor wafer W is immersed in cathode room 1D of the electrolytic plating organ bath 1 through a supporter 2 in this condition as shown in (a) of drawing 6 , air bubbles A will pile up in the processed side of the semi-conductor wafer W. Then, if a predetermined electrical potential difference is impressed after rotating the semi-conductor wafer W through a supporter 2 and driving out air bubbles A conjointly with the upward flow of the constant flow of plating liquid 3, a current will flow between an anode 4 and cathode 2B through plating liquid 3, and coppering will be performed to the semi-conductor wafer W. Under the present circumstances, within cathode room 1D, since the upward flow of the constant flow of plating liquid 3 is formed as an arrow head shows to drawing 5 R> 5, and the semi-conductor wafer W is moreover rotating through a supporter 2, the plating liquid 3 in contact with the semi-conductor wafer W is always updated, and stable coppering is performed.
[0007] By the way, the coppering layer is formed in the processed side of the semi-conductor wafer W, after circulating plating liquid 3 by the fixed flow rate and driving out the air bubbles A within a processed side, while rotating the semi-conductor wafer W with a fixed rotational speed, after the semi-conductor wafer W is immersed in plating liquid 3 in performing coppering to the semi-conductor wafer W.
[0008]
[Problem(s) to be Solved by the Invention] However, although air bubbles A are certainly driven out of the processed side of the semi-conductor wafer W to a case, the effect of air bubbles A is eliminated to it and it was made to perform coppering to the conventional electrolytic plating approach, the technical problem that a setup of the rotational speed of the semi-conductor wafer W at the time of driving out air bubbles A certainly or the amount of circulating flow of plating liquid 3 was difficult, and it was very difficult to obtain the deposit of uniform thickness occurred.
[0009] This invention was made in order to solve the above-mentioned technical problem, and it aims at offering the electrolytic plating approach that the deposit of uniform thickness can be obtained certainly.

[0010]
[Means for Solving the Problem] this invention person acquired the following knowledge, as a result of examining the conditions of plating processing, especially air bubbles A in a detail about the rotational speed of the supporter 2 for ******ing certainly, or the amount of circulating flow of plating liquid 3, in order to obtain the deposit of thickness uniform in order to solve the above-mentioned technical

problem. For example, although a certain amount of rotational speed was needed for driving out air bubbles A quickly, when rotational speed was too quick, it turned out A [cellular] That air bubbles A gather in the center of a processed side, and do not fall out on the contrary. Moreover, when the rotational speed of a supporter 2 was too slow conversely, it also turned out that the seed layer of the semi-conductor wafer W begins to melt into plating liquid 3, and a deposit becomes an ununiformity. Furthermore, it turned out that specific conditions must be set up for securing the homogeneity of a deposit about the amount of circulating flow of plating liquid 3 at the time of a cellular purge and plating processing, and plating liquid 3 must be circulated.

[0011] This invention is what was made based on the above-mentioned knowledge. The electrolytic plating approach according to claim 1 The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. It is the electrolytic plating approach of performing plating processing while making the plating liquid in the above-mentioned electrolytic plating organ bath rotating the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter. The process which drives out the air bubbles which are made to circulate through the above-mentioned plating liquid through the above-mentioned circulation drive, and pile up in the liquid-facing surface of the above-mentioned processed object when immersed in the above-mentioned plating liquid, It is characterized by having the process which changes the flow rate of the above-mentioned plating liquid through the above-mentioned circulation drive, and performs plating processing to the above-mentioned processed object.

[0012] Moreover, the electrolytic plating approach of this invention according to claim 2 The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. It is the electrolytic plating approach of performing plating processing while making the plating liquid in the above-mentioned electrolytic plating organ bath rotating the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter. The process which drives out the air bubbles which are made to rotate the above-mentioned processed object through the above-mentioned supporter, and pile up in the liquid-facing surface of the above-mentioned processed object when immersed in the above-mentioned plating liquid, It is characterized by having the process which changes the rotational speed of the above-mentioned processed object through the above-mentioned supporter, and performs plating processing to the above-mentioned processed object.

[0013] Moreover, the electrolytic plating approach of this invention according to claim 3 The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. It is the electrolytic plating approach of performing plating processing while making the plating liquid in the above-mentioned electrolytic plating organ bath rotating the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter. The process which drives out the air bubbles which are made to rotate the above-mentioned processed object through the above-mentioned supporter, and pile up in the liquid-facing surface of the above-mentioned processed object while circulating the above-mentioned plating liquid through the above-mentioned circulation drive, when immersed in the above-mentioned plating liquid, It is characterized by having the process of the flow rate of the above-mentioned plating liquid, and the rotational speed of the above-

mentioned processed object which changes either at least and performs plating processing to the above-mentioned processed object.
[0014] Moreover, the electrolytic plating approach of this invention according to claim 4 The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. The process which is the electrolytic plating approach of performing plating processing, making the plating liquid in the above-mentioned electrolytic plating organ bath rotate the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter, and impresses a current to the above-mentioned processed object, It is characterized by having the process immersed in the above-mentioned plating liquid in the above-mentioned processed object through the above-mentioned supporter where a current is impressed to the above-mentioned processed object, and the above-mentioned cathode and the process which detects the current change between the above-mentioned anodes.
[0015]
[Embodiment of the Invention] Hereafter, this invention is explained based on the operation gestalt shown in drawing 1 - drawing 4 . First, the electrolysis gilding machine used for the electrolytic plating approach of this invention is explained. As this electrolysis gilding machine 10 is shown in (a) of drawing 1 , and (b) The electrolytic plating organ bath 12 which holds the plating liquid 11 for performing coppering to the processed object (for example, semi-conductor wafer) W, The diaphragm 15 which divides the inside of this electrolytic plating organ bath 12 in the bottom room 13 and the top room 14, The anode 16 arranged in the bottom room 13 divided through this diaphragm 15, It has the cathode 17 which makes this anode 16 and pair, and has the supporter 18 held possible [a cathode 17 (refer to (b) of drawing 1) and a flow of the semi-conductor wafer W], the semi-conductor wafer W is immersed in the plating liquid 11 in the electrolytic plating organ bath 12, and it has been made to perform coppering. In addition, below, a bottom room explains an anode room and a top room as a cathode room.
[0016] It ** and the above-mentioned electrolytic plating organ bath 12 is constituted as double-frame construction equipped with for example, inner lift 12A and outside tub 12B. The supply pipe 19 is penetrated and formed in the base of this electrolytic plating organ bath 12. The diaphragm 15 has the hole in the center. The hole of a diaphragm 15 is connected with the upper limit section of a supply pipe 19, the periphery edge is connected with the peripheral wall of inner lift 12A, and the electrolytic plating organ bath 12 is divided up and down as mentioned above through the diaphragm 15. Moreover, an anode 16 is formed with the phosphorus-containing copper which uses copper as a principal component, and the cathode 17 is formed in the shape of a ctenidium with the stainless steel with which for example, platinum plating was performed. The supporter 18 is constituted so that the drive which is not illustrated may be minded and it may go up and down and rotate at a proper setting rate at least. It is made to have not penetrated the impurity which this diaphragm 15 was formed as a membrane filter which carried out extension shaping of the polyvinylidene fluoride which titanium oxide contained, for example, was generated in the anode room 13.
[0017] Opening of the upper limit of the above-mentioned supply pipe 19 is carried out in the cathode room 14, and the lower limit is connected to the end of the circulation piping 20. Tank 20A and pump 20B are arranged at this circulation piping 20, and the other end of the circulation piping 20 is connected to the base of the annular room 21 between inner lift 12A and outside tub 12B. Therefore, the plating liquid 11 in tank 20A is supplied by the drive of pump 20B into the cathode room 14 via a supply pipe 19, and after the most goes up the cathode room 14 and contacts the processed side of the semi-conductor wafer W, it overflows from the cathode room 14 to the annular room 21. It circulates through overflowing plating liquid 11 repeatedly via the circulation piping 20 between return, the cathode room 14, and tank 20A into tank 20A. Moreover, the circulation piping 22 is connected also to the base of the

anode room 13, and tank 22A and pump 22B are arranged at this circulation piping 22. Therefore, it circulates [like the case of the cathode room 14] through the plating liquid 11 in tank 22A repeatedly between the anode room 13 and tank 21A by the drive of pump 22B.
[0018] Moreover, it is formed in tubed [which upper limit closed], and installation section 18A of the semi-conductor wafer W horizontally prolonged to the inner direction is formed in the lower limit in the shape of a flange (a) a of drawing 1 So that the above-mentioned supporter 18 may be shown. And the vacuum chuck 24 and the clamp device 25 which were constituted possible [rise and fall] through air cylinders 24A and 25A are attached in this supporter 18, and the semi-conductor wafer W is delivered to it between the wafer conveyance devices which are not illustrated through these devices 24 and 25. A vacuum chuck 24 carries out vacuum adsorption, and holds the center of the semi-conductor wafer W. The clamp device 25 is formed in the shape of a ring, presses the periphery edge of the semi-conductor wafer W, and is fixed. Proper configurations, such as the shape of a military hat, can be used for the clamp device 25 if needed. Moreover, installation section 18A of a supporter A18 is equipped with a cathode 17 as shown in (b) of this drawing, and it is equipped with the seal member 23 with elasticity inside the cathode 17.
[0019] And opening 18B for carrying out taking-out close [of the semi-conductor wafer W] to the peripheral wall of a supporter 18 is formed, after carrying out vacuum adsorption of the semi-conductor wafer W carried in in the supporter 18 from this opening 18B by the vacuum chuck 24, a vacuum chuck 24 descends and the semi-conductor wafer W is laid to installation section 18A. While a vacuum chuck 24 goes up succeedingly, the clamp device 25 descends and the periphery edge of the semi-conductor wafer W is pressed to installation section 18A. Thereby, while the semi-conductor wafer W intercepts the inside of a supporter 18 from the outside by the seal member 23, the flow of the seed layer (not shown) formed in the semi-conductor wafer W is electrically attained with a cathode 17.
[0020] Moreover, the above-mentioned anode 16 and the cathode 17 are connected to the constant current power supply 27 through wiring 26, as shown in (a) of drawing 1 . Therefore, if the semi-conductor wafer W is immersed in the cathode room 14 of the electrolytic plating organ bath 12 through a supporter 18 and a constant current power supply 27 is impressed, a flow will become free electrically through plating liquid 11, coppering is performed to the processed side of the semi-conductor wafer W, and a plating side is formed in it at the cathode room 14.
[0021] Furthermore, the above-mentioned electrolysis gilding machine 10 is equipped with the control unit (not shown) which controls a supporter 18 and Pumps 20B and 22B, and has controlled optimally the rotational speed of a supporter 18, and the circulation velocity (flow rate) of plating liquid 11 with Pumps 20B and 22B at least according to the processing conditions of plating. And a supporter 18 can be enforced by work of this control unit, and if it puts in another way, the electrolytic plating approach of this invention can be enforced by controlling the rotational speed of the semi-conductor wafer W, and the amount of circulating flow of the plating liquid 11 in the cathode room 14 (the amount of upward flow). By the conventional electrolytic plating approach, since the rotational speed of the semi-conductor wafer when performing the time of driving out air bubbles A and plating processing and the amount of upward flow of plating liquid were both set up identically, the optimum conditions at the time of a cellular purge and the optimum conditions at the time of plating are not in agreement, and it is thought that uniform thickness was not obtained.
[0022] Then, after the semi-conductor wafer W is immersed, he is trying to obtain the coppering layer of uniform thickness by this invention by changing suitably the rotational speed of the supporter 18 when performing the time of driving out the air bubbles A which pile up in a processed side, and plating, and/or the amount of upward flow of plating liquid 11 through a control unit, respectively.
[0023] When driving out air bubbles A in this invention, it is desirable to set the rotational speed of a supporter 18 as 20 - 60rpm. With the rotational speed of this range, air bubbles A can be driven out by the very short time amount of less than 1 second. In less than 20 rpm, while the purge of air bubbles A takes long duration, there is a possibility that the seed layer of the semi-conductor wafer W may begin to melt. When 80rpm is exceeded, there is a possibility that air bubbles A may focus in the center of a processed side, and air bubbles A cannot be driven out. Moreover, if it says about the upward flow of

plating liquid 11, it is desirable to set the amount of upward flow as a part for 0 - 8L/. In the amount of upward flow of this range, air bubbles A can be driven out within 1 second. If a part for 10L/is exceeded, the oil level of plating liquid 11 will confine air bubbles A in a dry area and the corner in which air bubbles A are formed by installation section 18A of the processed side of the semi-conductor wafer W, and a supporter 18, and there is a possibility of being on the contrary hard that it may come to ****** air bubbles A. The amount of upward flow is a thing on condition of a part for 0L/rotating in the rotational-speed range are above-mentioned [a supporter 18] in the range.
[0024] Moreover, in order to stabilize the copper ion near the liquid-facing surface of the processed side of the semi-conductor wafer W for air bubbles A to fixed concentration at the time of plating after dismissal, plating liquid 11 is supplied by the upward flow of a to some extent bigger flow rate than the time of a cellular purge, and he is trying to update quickly the plating liquid 11 which touches a processed side. Furthermore, also in order to equalize the copper ion concentration of the whole processed side surface, he is trying to rotate the semi-conductor wafer W with a to some extent bigger rotational speed than the time of a cellular purge. Thereby, equalization of the copper ion concentration in a processed side, as a result equalization of the thickness of a copper ion layer can be attained.
[0025] Furthermore, he is trying to check by the continuity test whether air bubbles A have been driven out certainly in this invention. That is, where the plating liquid 11 in the cathode room 14 is circulated in the predetermined amount of upward flow, after the semi-conductor wafer W is immersed in the cathode room 14, the semi-conductor wafer W is rotated with a predetermined rotational speed. He is trying to check whether immediately after this, air bubbles A are piling up by measuring a sink, the resistance at this time, or a current value for a minute current between an anode 16 and a cathode 17, and observing that abrupt change. That is, the purge of air bubbles A can be checked by whether a current value becomes large rapidly or resistance becomes small rapidly. And when each value does not change but constant value is reached, it can be checked that air bubbles A have been driven out completely.
[0026] Next, one example and the example of a comparison of this invention approach are explained, referring to drawing 1 - drawing 4 , in addition the semi-conductor wafer with a diameter of 200mm was used here. In [example 1] this example, if the semi-conductor wafer W carries in into a supporter 18 from opening 18B of a supporter 18 through the substrate P for conveyance first as shown in (a) of drawing 2 , and (b), a vacuum chuck 24 will drive, and as shown in (c) of drawing 2 , vacuum adsorption of the semi-conductor wafer W will be carried out. If the substrate P for conveyance cancels vacuum adsorption of the semi-conductor wafer W and retreats out of a supporter 18 succeedingly As shown in (d) of drawing 2 , while a vacuum chuck 24 descends to installation section 18A through air cylinder 24A and lays the semi-conductor wafer W to up to installation section 18A, the clamp device 25 descends through air cylinder 25A. As the arrow head of this drawing shows, the elasticity of the seal member 23 is resisted, and the periphery edge of the semi-conductor wafer W is pressed and fixed on installation section 18A. While the seal member 23 carries out elastic deformation and intercepts the inside of a supporter 18 from the outside by this, the seed layer and cathode 17 of the semi-conductor wafer W contact electrically, and the flow of these both W and 17 of them is attained. As shown in (e) of drawing 2 in the meantime, a vacuum chuck 24 goes up from the semi-conductor wafer W to the clamp device 25 and substitution. In addition, in the following drawings, illustration of the clamp device 25 is omitted and the arrow head has illustrated only the press direction.
[0027] Pumps 20B and 22B drive in the electrolytic plating organ bath 12. Moreover, tank 20A, The plating liquid 11 in 22A is supplied into the cathode room 14 and the anode room 13. Plating liquid 11 circulates between the cathode room 14 and the anode room 13, and each tank 20A and 22A, and as the arrow head of drawing 3 R> 3 (a) - (c) shows, in the cathode room 14, the upward flow of plating liquid 11 is always formed. Under the present circumstances, the amount of upward flow of the plating liquid 11 in the cathode room 14 was set as a part for 5L/.
[0028] After the semi-conductor wafer W descended in the level condition and was immersed in plating liquid 11 through a supporter 18 as shown in (a) of drawing 3 when plating liquid 11 circulates, the supporter 18 was rotated with the rotational speed of 30rpm through the control unit. Although air bubbles A were piling up in the processed side of the semi-conductor wafer W in the initial stage of

immersion at the semi-conductor wafer W bottom, as shown in (b) of drawing 3 R> 3, air bubbles A were conjointly driven out of the processed side of the semi-conductor wafer W out of the supporter 18 according to the upward flow of plating liquid 11 with rotation of the semi-conductor wafer W (refer to (c) of drawing 3). The purge of air bubbles A is ended within in 1 second. Termination of the purge of air bubbles was checked by the resistance value change by the minute current which impressed the semi-conductor wafer W when immersed.

[0029] After checking that air bubbles A had been lost, while changing the flow rate of the plating liquid 11 in the cathode room 14 into a part for 10L/from a part for 5L/, the predetermined electrical potential difference was impressed from the constant current power supply 27, coppering was started, and plating processing was performed for 4 minutes and 30 seconds. After plating termination, the semi-conductor wafer W was pulled up from plating liquid 11 by the reverse order, it took out out of the supporter 18, and the thickness of the plating side of the semi-conductor wafer W was measured. In addition, the time amount of the plating processing including the purge of air bubbles was 4 minutes and 30 seconds. The result of having measured the thickness of the coppering layer of the semi-conductor wafer W obtained by this processing was shown in (a) of drawing 4 . An axis of abscissa shows the dimension of the semi-conductor wafer W, and the center of an axis of abscissa of the graph shown in this drawing is the core of the semi-conductor wafer W. The axis of ordinate shows change of the thickness of a coppering layer. The thing with thin (resistance is high in poor membrane formation) thickness is shown, so that it comes on an axis of ordinate. According to the result which this graph shows, it turned out that it is thickness with the uniform coppering layer of the semi-conductor wafer W.

[0030] In the example of the [example 1 of comparison] book comparison, plating processing was performed like the example 1 except having set up identically to the flow rate at the time of a cellular purge the amount of upward flow of the plating liquid 11 at the time of plating processing. The thickness of the coppering layer of the semi-conductor wafer W obtained by this plating processing was measured, and that result was shown in (b) of drawing 4 . According to the result which this graph shows, the thickness of the core of the semi-conductor wafer W was a little thick, the thickness of a periphery edge was a little thin, and it turned out that it is inferior to homogeneity as compared with an example 1.

[0031] The example of the [example 2 of comparison] book comparison performed the purge of air bubbles, and plating processing on the same conditions as an example 1 except having made it stand it still without circulating plating liquid 11 from beginning to end. The thickness of the coppering layer of the semi-conductor wafer W obtained by this plating processing was measured, and that result was shown in (c) of drawing 4 . According to the result which this graph shows, the resistance of the periphery edge of the semi-conductor wafer W was extremely high, and it turned out that it has become poor membrane formation. Therefore, it is the proof which remains without the air bubbles A of the processed side of the semi-conductor wafer W and the corner of installation section 18A of a supporter 18 falling out.

[0032] As explained above, according to this operation gestalt, into plating liquid 11 after carrying out semi-conductor wafer immersion, Since the amount of upward flow of plating liquid 11 was changed into a part for 10L/and coppering was performed, after circulating plating liquid 11 in the amount of upward flow for 5L/and driving out the air bubbles A within a processed side, while rotating the semi-conductor wafer W with the rotational speed of 30rpm, Air bubbles A can be certainly driven out of the inside of the processed side of the semi-conductor wafer W in a short time, moreover the copper ion concentration of the whole processed side surface can be equalized, and the coppering layer of uniform thickness can be obtained stably. Moreover, while having driven out air bubbles A, a minute current can be impressed between an anode 16 and a cathode 17, and it can know certainly whether air bubbles A fell out completely by seeing a resistance value change.

[0033] In addition, although the case where the amount of upward flow of the plating liquid when performing plating processing rather than the amount of upward flow of the plating liquid when driving out air bubbles with the above-mentioned operation gestalt was set up greatly was explained, this invention person is checking that the same result is obtained, even if it sets up more greatly than the time of driving out air bubbles the rotational speed of the processed object at the time of plating, without

changing the flow rate of plating liquid. Moreover, even if it combines both approaches, it is checking that the same result is obtained. Moreover, although the semi-conductor wafer was mentioned as the example and the above-mentioned operation gestalt explained it as a processed object, this invention is applicable also about the substrate for LCD.
[0034]
[Effect of the Invention] According to invention of this invention according to claim 1 to 3, the electrolytic plating approach that the deposit of uniform thickness can be obtained certainly can be offered.
[0035] Moreover, according to invention of this invention according to claim 4, in case plating processing is performed, the electrolytic plating approach that it can check whether the air bubbles within the processed side of a processed object have fallen out certainly can be offered collectively.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. It is the electrolytic plating approach of performing plating processing while making the plating liquid in the above-mentioned electrolytic plating organ bath rotating the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter. The process which drives out the air bubbles which are made to circulate through the above-mentioned plating liquid through the above-mentioned circulation drive, and pile up in the liquid-facing surface of the above-mentioned processed object when immersed in the above-mentioned plating liquid, The electrolytic plating approach characterized by having the process which changes the flow rate of the above-mentioned plating liquid through the above-mentioned circulation drive, and performs plating processing to the above-mentioned processed object.
[Claim 2] The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. It is the electrolytic plating approach of performing plating processing while making the plating liquid in the above-mentioned electrolytic plating organ bath rotating the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter. The process which drives out the air bubbles which are made to rotate the above-mentioned processed object through the above-mentioned supporter, and pile up in the liquid-facing surface of the above-mentioned processed object when immersed in the above-mentioned plating liquid, The electrolytic plating approach characterized by having the process which changes the rotational speed of the above-mentioned processed object through the above-mentioned supporter, and performs plating processing to the above-mentioned processed object.
[Claim 3] The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. It is the electrolytic plating approach of performing plating processing while making the plating liquid in the above-mentioned electrolytic plating organ bath rotating the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter. The process which drives out the air bubbles which are made to rotate the above-mentioned

processed object through the above-mentioned supporter, and pile up in the liquid-facing surface of the above-mentioned processed object while circulating the above-mentioned plating liquid through the above-mentioned circulation drive, when immersed in the above-mentioned plating liquid, The electrolytic plating approach characterized by having the process of the flow rate of the above-mentioned plating liquid, and the rotational speed of the above-mentioned processed object which changes either at least and performs plating processing to the above-mentioned processed object.
[Claim 4] The electrolytic plating organ bath which holds the plating liquid for performing plating processing to a processed object, The migration and the pivotable supporter which have the anode arranged in this electrolytic plating organ bath, and the cathode which makes this anode and pair, and hold a processed object possible [a cathode and a flow], It has the circulation drive which is made to overflow the above-mentioned plating liquid from the above-mentioned plating organ bath, and is made to circulate through it. The process which is the electrolytic plating approach of performing plating processing, making the plating liquid in the above-mentioned electrolytic plating organ bath rotate the above-mentioned processed object in the condition of having been immersed, through the above-mentioned supporter, and impresses a current to the above-mentioned processed object, The electrolytic plating approach characterized by having the process immersed in the above-mentioned plating liquid in the above-mentioned processed object through the above-mentioned supporter where a current is impressed to the above-mentioned processed object, and the above-mentioned cathode and the process which detects the current change between the above-mentioned anodes.

[Translation done.]